

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Article 36 and Rule 70)

REC'D 27 APR 2005



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Applicant's or agent's file reference 108628/EBK		FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/NO 03/00429	International filing date (day/month/year) 19.12.2003	Priority date (day/month/year) 27.12.2002	
International Patent Classification (IPC) or both national classification and IPC C23F1/16			
Applicant LEIV EIRIKSSON NYSKAPING AS et al.			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
 - ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).
 - These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:
 - I ☒ Basis of the opinion
 - II ☐ Priority
 - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV ☐ Lack of unity of invention
 - V ☒ Reasoned statement under Rule 66.2(a)(II) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI ☐ Certain documents cited
 - VII ☐ Certain defects in the international application
 - VIII ☐ Certain observations on the international application

Date of submission of the demand 15.07.2004	Date of completion of this report 26.04.2005
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Mizera, E Telephone No. +49 89 2399-8580 

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/NO 03/00429**

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-15 as originally filed

Claims, Numbers

1-27 filed with telefax on 09.03.2005

Drawings, Sheets

1/7-7/7 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

**INTERNATIONAL PRELIMINARY
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5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	
	No: Claims	1-27
Inventive step (IS)	Yes: Claims	
	No: Claims	1-27
Industrial applicability (IA)	Yes: Claims	1-27
	No: Claims	

2. Citations and explanations

see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/NO 03/00429

AS TO BOX V:

1. The following documents are cited:

D1: DATABASE WPI

Week 198722,
Derwent Publications Ltd., London, GB;
Class E17, AN 1987-155333, XP002973641
& SU 1 135 382 A (AS USSR RADIOTECHN) 15
October 1986

**D2: "JIAN GUI-ZHOU ET AL: 'Study of a new
etchant for GaSb/AlGaAsSb device
fabrication'
JOURNAL OF FUNCTIONAL MATERIALS AND DEVICES
vol. 7, no. 1, 2001,
pages 1 - 2, XP008034735**

D3: DATABASE WPI

Week 197740,
Derwent Publications Ltd., London, GB;
Class L03, AN 1977-71946Y, XP002973642
& JP 52 035 993 B (MATSUSHITA ELEC IND CO
LTD) 12 September 1977

D4: DATABASE WPI

Week 198229,
Derwent Publications Ltd., London, GB;
Class L03, AN 1982-60969E, XP002973643
& SU 784 635 A (AS USSR RADIO ELTRN) 30
January 1982

D5: DATABASE WPI

Week 200229,
Derwent Publications Ltd., London, GB;
Class L03, AN 2002-227705, XP002973644
& CN 1 328 175 A (SHNAGHAIMETALLURGY INST
CHINESE ACAD SC) 26 December 2001

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/NO 03/00429

2. All of documents D1-D5 disclose a wet etchant comprising hydrogen peroxide as oxidising agent and hydrofluoric acid. Further all of these documents disclose an organic acid contained in this etchant (which is lactic acid in D1 and D5, tartaric acid in D2 and D4 and acetic acid in D3).
3. For this reason **(and also because the intended use -' for etching...' - does not represent a restricting feature of a product claim)** claim 1 and claims 2-8, depending thereon, do not meet the requirements of Art.33(2) and (3) PCT. In this context it is added that the distinction, concerning different cases for z, is irrelevant for this product claim, directed exclusively to the wet etchant composition.
4. This applies also to claim 9 and depending claims 10-19 with regard to the disclosure of of D1. This document discloses the use of lactic acid for the case of $z=0$.
5. Claim 20 is defined partly in terms of a product obtained by a specific process. Quite apart from the fact that this product is known from each of D1 or D2, it is stressed that it is highly unclear to recognize by which process the finished product has been made and by which features this product should be distinguishable from similar products known from the prior art.
6. For these reasons novelty and inventive step of claim 20 with depending claims 21-27 cannot be acknowledged (Art.33(2) and (3) PCT).
7. Finally it is pointed out that a basis for the presence of citric acid, lactic acid **and** acetic acid in the same etchant, as required by claim 1, has not been found. It seems that 'and ' should be replaced by 'or' in this case.

New Patent Claims**Dated 9 March 2005**

1. A wet acid etchant for wet acid etching of intrinsic, n-doped or p-doped $\text{Al}_{1-x-z}\text{Ga}_x\text{In}_z\text{As}_{1-y}\text{Sb}_y$ with $0 < x < 1$, $0 < y < 1$, $0 \leq z < 1$ and $0 < x+z < 1$, comprising that the etchant is mixed in a solvent (or water) comprising:

- a1) organic acid when $z > 0$; or
- a2) citric acid, lactic acid and acetic acid when $z = 0$
- b) oxidizing agent; and
- c) hydrofluoric acid.

2. The wet acid etchant according to claim 1, wherein the organic acid under a1) or a2) is neat or a mixture.

3. The wet acid etchant according to claim 1, wherein when $z > 0$, the organic acid is selected from citric acid, lactic acid, acetic acid and tartaric acid.

(former claim 4 incorporated into claim 1)

4. The wet acid etchant according to claim 1, wherein the oxidizing agent is hydrogen peroxide (H_2O_2).

5. The wet acid etchant according to claim 1, wherein the oxidizing agent is an oxide-forming chemical, e.g. NaOCl or Ozone.

6. The wet acid etchant according to claim 1, wherein the wet etchant comprises:

- a) up to 90 wt-% of the organic acid under a1) or a2),
- b) up to 50 wt-% of oxidizing agent; and
- c) up to 25 wt-% of hydrofluoric acid,

all wt-% are based on the total weight of the composition, the balance is made up by a solvent, preferably water.

7. The wet acid etchant according to claim 6, wherein the wet acid etchant comprises:

- a) up to 75 wt-% of the organic acid under a1) or a2),
- b) up to 25 wt-% of oxidizing agent; and
- c) up to 15 wt-% of hydrofluoric acid,

all wt-% are based on the total weight of the composition, the balance is made up
5 by a solvent, preferably water.

8. The wet acid etchant according to claim 6, wherein the wet acid etchant comprises:

- a) up to 60 wt-% of the organic acid under a1) or a2),
- 10 b) up to 15 wt-% of oxidizing agent; and
- c) up to 10 wt-% of hydrofluoric acid,

all wt-% are based on the total weight of the composition, the balance is made up
by a solvent, preferably water.

15 9. A process for wet acid etching of intrinsic, n-doped or p-doped

$\text{Al}_{1-x-z}\text{Ga}_x\text{In}_z\text{As}_{1-y}\text{Sb}_y$ with $0 < x < 1$, $0 < y < 1$, $0 \leq z < 1$ and $0 < x+z < 1$, comprising
contacting an $\text{Al}_{1-x-z}\text{Ga}_x\text{In}_z\text{As}_{1-y}\text{Sb}_y$ material with a wet acid etchant mixed in a
solvent (or water) comprising:

- a1) organic acid when $z > 0$; or
- 20 a2) citric acid, lactic acid or acetic acid when $z = 0$
- b) oxidizing agent, and
- c) hydrofluoric acid.

10. The process according to claim 9, wherein the organic acid under a1) or a2)
25 is neat or a mixture.

11. The process according to claim 9, wherein the when $z > 0$ organic acid is
selected from citric acid, lactic acid, acetic acid and tartaric acid.

30 (Former claim 13 incorporated into claim 9)

12. The process according to claim 9, wherein the oxidizing agent is hydrogen
peroxide (H_2O_2).

13. The process according to claim 9, wherein the oxidizing agent is an oxide-forming chemical, e.g. NaOCl or Ozone.

14. The process according to claim 9, wherein the wet etchant comprises:

- a) up to 90 wt-% of the organic acid under a1) or a2),
- b) up to 50 wt-% of oxidizing agent; and
- c) up to 25 wt-% of hydrofluoric acid,

all wt-% are based on the total weight of the composition, the balance is made up by a solvent, preferably water.

15. The process according to claim 9, wherein the wet acid etchant comprises:

- a) up to 75 wt-% of the organic acid under a1) or a2),
- b) up to 25 wt-% of oxidizing agent; and
- c) up to 15 wt-% of hydrofluoric acid,

all wt-% are based on the total weight of the composition, the balance is made up by a solvent, preferably water.

16. The process according to claim 9, wherein the wet acid etchant comprises:

- a) up to 60 wt-% of the organic acid under a1) or a2),
- b) up to 15 wt-% of oxidizing agent; and
- c) up to 10 wt-% of hydrofluoric acid,

all wt-% are based on the total weight of the composition, the balance is made up by a solvent, preferably water.

17. The process according to claim 9, wherein one or more cap layer(s) is (are) applied on the $\text{Al}_{1-x}\text{Ga}_x\text{In}_z\text{As}_{1-y}\text{Sb}_y$ semiconductor surface or structure so that patterning of said semiconductor is achieved without any reaction at the interface between the surface of the $\text{Al}_{1-x}\text{Ga}_x\text{In}_z\text{As}_{1-y}\text{Sb}_y$ semiconductor and a masking material which is also applied on the semiconductor surface.

18. The process according to claim 17, wherein the cap layer is GaSb, InSb, GaAs, InAs, GaInSb, GaInAs, InAsSb, GaAsSb, GaInAsSb or other non-oxidizing material and the masking material is selected from a photo resist, oxides, nitrides, carbides, diamond-film, semiconductors or metals. (former claim 20 incorporated)

19. The process according to claim 9 wherein the $\text{Al}_{1-x-z}\text{Ga}_x\text{In}_z\text{As}_{1-y}\text{Sb}_y$ semiconductor surface or structure is exposed to H_2O_2 , and the organic acid and hydrofluoric acid in a two step manner.

20. An optical or optoelectronic semiconductor structure prepared by wet acid etching of $\text{Al}_{1-x-z}\text{Ga}_x\text{In}_z\text{As}_{1-y}\text{Sb}_y$ with $0 < x < 1$, $0 < y < 1$, $0 \leq z < 1$ and $0 < x + z < 1$, by contacting a semiconductor comprising $\text{Al}_{1-x-z}\text{Ga}_x\text{In}_z\text{As}_{1-y}\text{Sb}_y$ material with a wet acid etchant comprising:

- a1) organic acid when $z > 0$; or
- a2) citric acid, lactic acid or acetic acid when $z = 0$;
- b) oxidizing agent; and
- c) hydrofluoric acid.

21. A semiconductor structure according to claim 20 wherein the the whole or parts of the $\text{Al}_{1-x-z}\text{Ga}_x\text{In}_z\text{As}_{1-y}\text{Sb}_y$ semiconductor material(s) the structure is composed of, is n-doped with Tellurium or other n-dopant, or p-doped with Beryllium or other p-dopant.

22. The semiconductor structure according to claim 21 wherein the etched material is part of a laser, Light-Emitting-Diode(LED), photodetector or optical waveguide structure.

23. The semiconductor structure according to claim 21 wherein the laser or optical waveguide structure is a ridge.

24. The semiconductor according to claim 22 or 23 wherein the laser is a Fabry Perot laser, Distributed Feedback/Reflector Laser (DFB/DBR) or Interferometric laser (as Y-laser or alike).

25. The semiconductor according to claim 22 wherein the etched material is part of a Vertical-Cavity Surface-Emitting Laser (VCSEL).

26. The semiconductor according to claim 22 wherein the etched material is part of a photonic crystal structure as Photonic Crystal Distributed Feedback Laser or alike.

5 27. The semiconductor according to claim 22 wherein the etched material is part of an optical sensor.